

11 – Evansville, Indiana

Exceptional Events Detail

Parameter:	PM _{2.5}
Dates:	May 24 – 30, 2007
Location:	Evansville – Vanderburgh Co.
Event:	Smoke from wildfires in northern Florida and southern Georgia impacted the Evansville region during the period of May 24 – 30. The gradual buildup of smoke moving through the area during this period resulted in elevated levels of the 24-hour PM _{2.5} .
Data:	Different analyses of the data are used to demonstrate that the PM _{2.5} concentrations measured from May 24 – 30 are beyond the range of values typically found during that time period and that they have been influenced by outside events. Table 11.1 shows daily PM _{2.5} averages prior to, during and after the event with the values flagged in bold . Data have been flagged with an exceptional event flag of ‘E’ in AQS, awaiting concurrence from EPA.

Tables 11.2 and 11.3 list summaries of the data collected at the three Evansville sites since 2000. Data from 2007 are calculated with all current data and with the flagged data removed. There was a significant improvement in the design values for the annual averages when removing the flagged values.

The values recorded during the May 24-30 time period are higher than the normal values collected during the month of May. Prior to this time, the highest value reported in May since 2000 had been 25 ug/m³ and the highest monthly average had been 14.95 ug/m³. With the high data collected in May 2007, the highest value was 29.9 ug/m³ and the highest monthly average was 22.06 ug/m³. Removing the flagged data results in a maximum daily concentration of 24.2 ug/m³ and a highest monthly average concentration of 18.94 ug/m³. These values are much more in line with historical data.

**Table 11.1 - FRM Daily Values
Exceptional Event Period**

Values in **BOLD** are flagged as exceptional events

Date	Evan - Civic Center 18-163-0006	Evan - Mill Rd 18-163-0012	Evan - U of E 18-163-0016
5/17/07			
5/18/07	7.8		8.8
5/19/07			
5/20/07			
5/21/07	15		14.9
5/22/07			
5/23/07			
5/24/07	26.2	23.9	25.8
5/25/07			
5/26/07			
5/27/07		29.9	27.7
5/28/07			
5/29/07			
5/30/07	26.5	28	27.6
5/31/07			
6/1/07			
6/2/07		19.8	22.3
6/3/07			

Table 11.2 - Historical Daily Values

		Ev - Civic Cntr. 181630006		Ev - Mill Rd 181630012		Ev - U of E 181630016	
Year		98th %ile	Daily Design Value ¹	98th %ile	Daily Design Value ¹	98th %ile	Daily Design Value ¹
2000		37.3		34.3		33.5	
2001		36.4		34.2		37.9	
2002	2000- 2002	46.7	40	44.9	38	46.2	39
2003	2001- 2003	34.5	39	34.1	38	35.9	40
2004	2002- 2004	28.3	37	27.6	36	28.3	37
2005	2003- 2005	42.5	35	41.5	34	37	34
2006	2004- 2006	30.5	34	27.9	32	29.5	32
2007	2005- 2007	33.6	36	29.9	33	31.5	33
		Values excluding flagged data					
2007	2005- 2007	33.6	36	29.1	33	31.5	33

¹Daily Design Value = 3 year average of annual 98th %ile values.

Table 11.3 - Historical Annual Averages

		Ev - Civic Cntr. 181630006		Ev - Mill Rd 181630012		Ev - U of E 181630016	
Year		Annual Ave.	Annual Design Value ²	Annual Ave.	Annual Design Value ²	Annual Ave.	Annual Design Value ²
2000		16.2		16.2		15.7	
2001		15.5		15.2		16.2	
2002	2000-2002	15.4	15.7	15.3	15.5	15.2	15.7
2003	2001-2003	14.9	15.2	15.3	15.2	15.1	15.5
2004	2002-2004	13.2	14.5	13.5	14.7	13.7	14.7
2005	2003-2005	16.5	14.9	16.3	15	16.7	15.1
2006	2004-2006	13.7	14.5	14.1	14.6	14.2	14.8
2007	2005-2007	13.9	14.7	14.2	14.9	14.2	15
		Values excluding flagged data					
2007	2005-2007	13.7	14.6	13.9	14.7	13.9	14.9

²Annual Design value = 3 year average of the annual averages.

Table 11.4 – Examination of Daily Maximums and Averages for May Monitored Values for 2000 – 2007 (Evansville – Mill Rd)

Year	Maximum Values	Monthly Averages
2000	21.2	14.74
2001	22.4	13.38
2002	18.4	14.48
2003	15.3	10.84
2004	18.9	13.12
2005	25	14.95
2006	21.2	10.56
2007	29.9	22.06
Values with flagged data removed		
2007	24.2	18.94

Particulate

Composition: Speciation data are collected at the Evansville – Mill Rd. site (181630012) on a one in six day sampling schedule. Data are available for May 24 and May 30. High organic carbon values were reported on those two dates; 8.03 ug/m³ and 7.40 ug/m³ respectively. These values were the highest and the fourth highest values of the year. The 2007 annual average for organic carbon at this site is 3.45 ug/m³. There was no increase in the elemental carbon values; 0.68 ug/m³ and 0.84 ug/m³, on the two dates, as compared to the annual average of

0.63ug/m³. The high organic carbon values, without an increase in elemental carbon, are a very good indicator of biomass combustion.

Maps with the plotted organic carbon values during the May 18 through June 5 are in Appendix 3. The time progression of the maps shows the rise and fall of the organic carbon values over this time period.

Maps: Images of maps from NOAA Satellite and Information Services show the smoke plume originating from the northern Florida/southern Georgia region. Dispersion and movement of the smoke plume from these fires was generally to the west or northwest and then to the north. The daily satellite smoke photos show that the smoke plume from the fires comes into southern Indiana on May 23 and continues to influence the atmosphere until June 2. The daily wind roses generally track the direction of the smoke plume on that day at the local level. The daily wind roses show information on prevailing wind direction, calm conditions and wind speed. (Note: Met data are from industrial site 181730002. Data were input into the State database to obtain the wind rose processed under the St Philips site name.) NOAA weather maps are also used to show that an upper level trough greatly influences the direction of the plume in relation to the SW Indiana region.

Trajectory Modeling: The NOAA HYSPLIT Models are used to show wind trajectories at different levels during this event. Backward modeling from the site (latitude: 38.02°; longitude: -87.57°) at elevations of 25m, 150m and 500m was conducted for a period of three (3) to four (4) days prior. The differing elevations were chosen to demonstrate the air mass's uniformity at ground-level where the samplers were located and aloft which avoids the ground-level limitations of the model. Forward modeling was conducted using the Bugaboo Scrub Fire as the starting point (latitude: 30.70°; longitude: -82.40°) at an elevation of 250 meters (appropriate height that is low enough to always be in the well-mixed zone and high enough to avoid the ground-level model limitation) and going three (3) to four (4) days. Overall, there is a very good correlation when comparing the forward and backward trajectories for a given date. May 24, 27, and 30 show a very narrow channel of air flow between southeastern Georgia and southwestern Indiana. Both the backward and forward trajectories confirm this. Forward trajectory modeling results are shown in Appendix 2.

Conclusion: EPA defines an “exceptional event” as an unusual or naturally occurring event that can affect air quality but is not reasonably controllable by state and local agencies. Exceptional events are events for which the normal planning and regulatory process established by the clean air act is not appropriate. Indiana has illustrated through the use of maps, meteorological data, speciation data, trajectory models and historical data that the smoke from wildfires in Florida and Georgia impacted the Evansville region during the period of May 24 – 30, 2007 causing elevated levels of the PM_{2.5} 24-hour standard and significantly increasing the annual average. According to 40 CFR Part 50.14 (b)(1), “EPA shall exclude data from use in

determinations of exceedances and NAAQS violations where a State demonstrates to EPA's satisfaction that an exceptional event caused a specific air pollution concentration in excess of one or more national ambient air quality standards at a particular air quality monitoring location and otherwise satisfies the requirements of this section." IDEM believes they have successfully illustrated the impact of this event on the sites in this region.

Therefore, IDEM requests that EPA concur with the 'E' flag on the data in AQS for the data in **bold** in Table 11.1.

NOAA Satellite Smoke Maps, Weather Maps, and Wind Roses

The smoke map shows that the plume has reached the Evansville area and as shown in Table 11.1, $PM_{2.5}$ levels have started to increase. The corresponding wind rose and weather map further illustrate the direction of the plume by the location of the upper level trough (orange dashed line) and the S, SE prevailing winds.

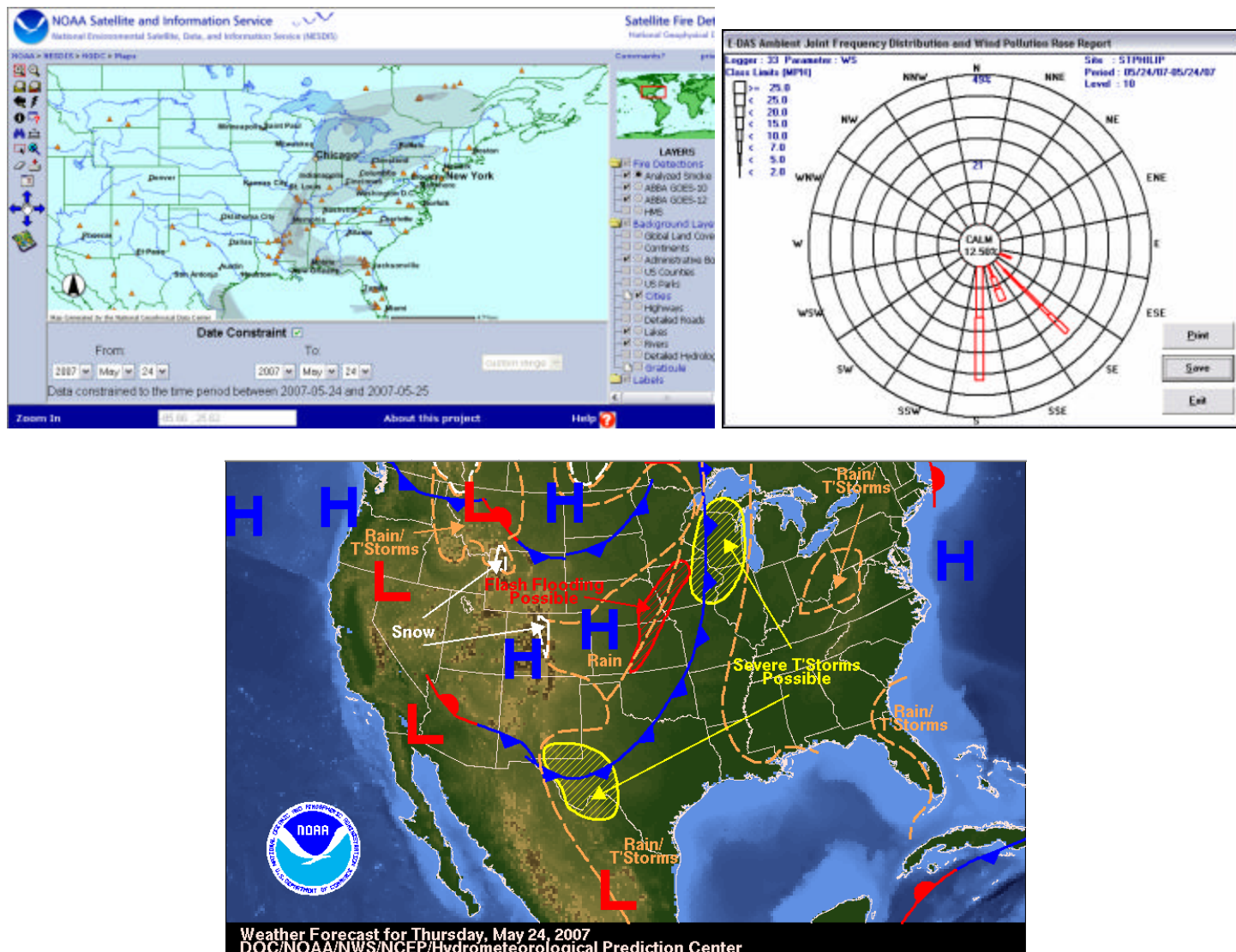


Figure 11.1 - May 24, 2007

The smoke map illustrates that the plume stalls as the trough keeps the smoke pushed to the south. However, due to the predominately calm wind conditions the stagnant air mass continues to cause the PM_{2.5} levels to remain elevated.

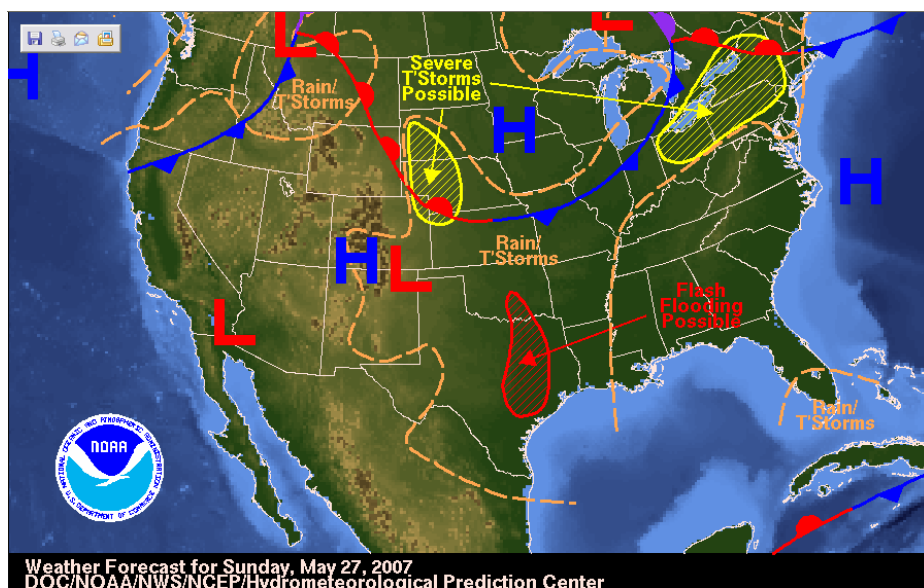
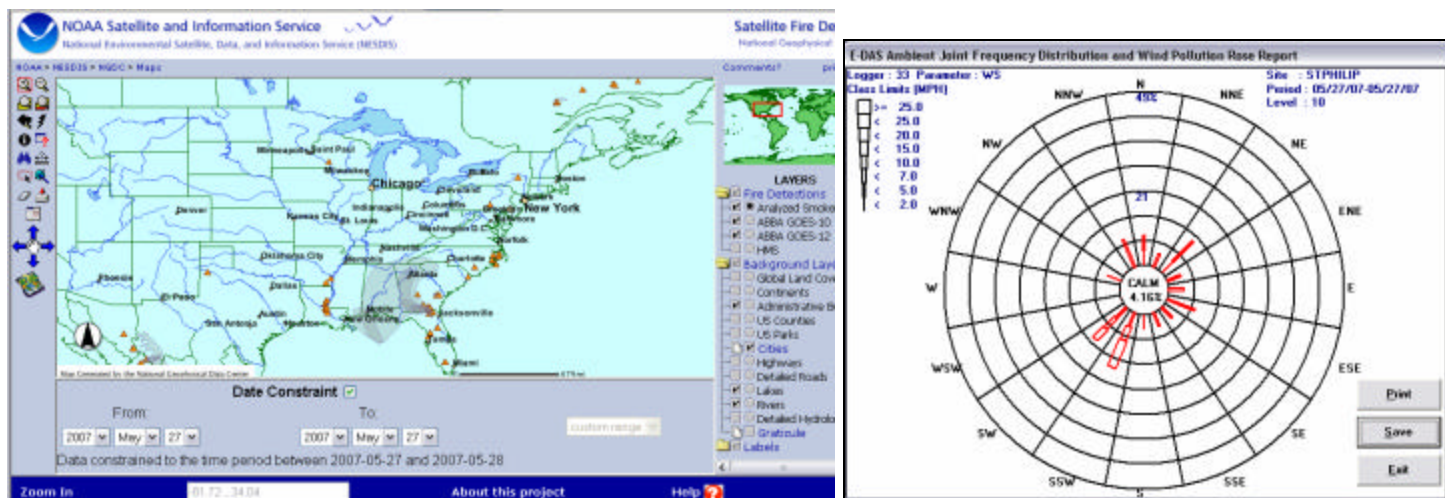


Figure 11.2 - May 27, 2007

The map shows the plume has moved back over the region as the upper level trough dips down over the area and the wind direction continues to be from the S, SE.

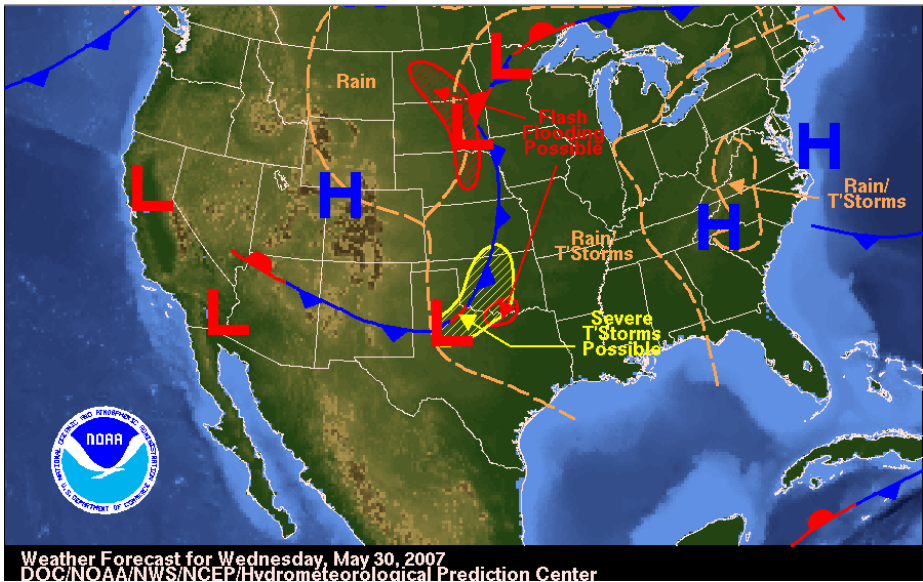
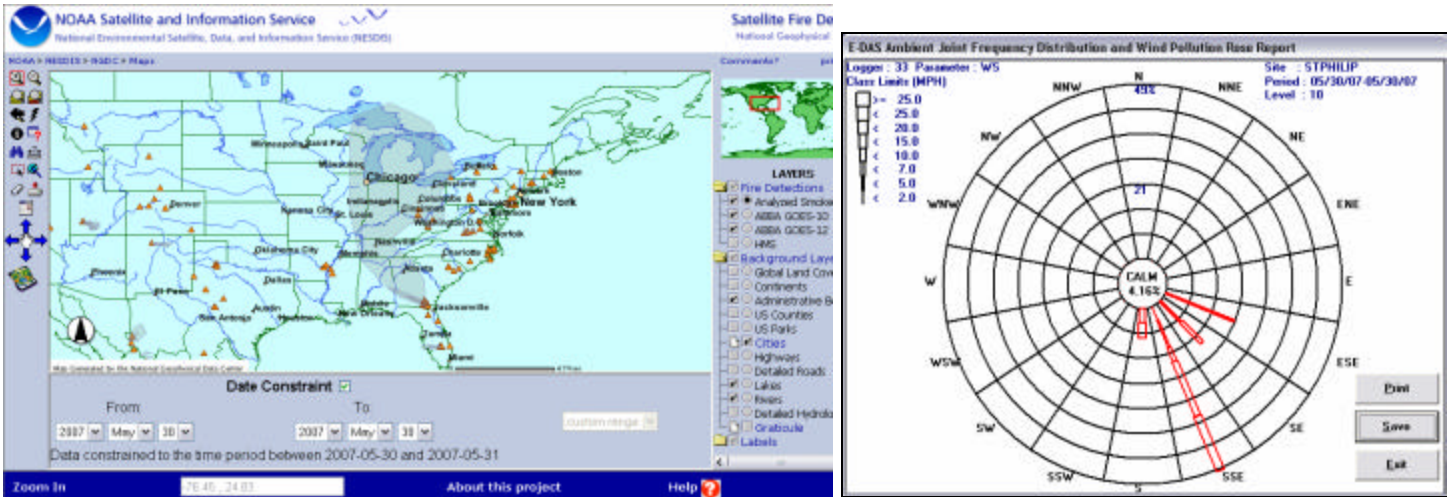


Figure 11.3 - May 30, 2007

Back Trajectory Models

NOAA ARL READY HYSPLIT Maps

Draxler, R.R. and Rolph, G.D., 2003. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (<http://www.arl.noaa.gov/ready/hysplit4.html>). NOAA Air Resources Laboratory, Silver Spring, MD.

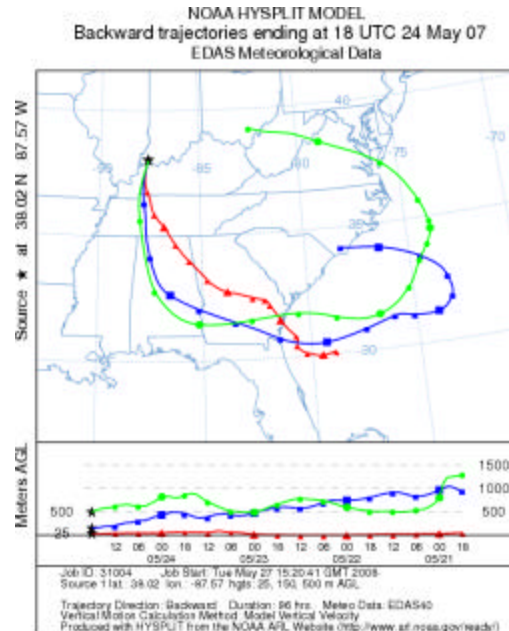


Figure 11.4: Backward trajectories originating from Evansville on 5/24/07 at 12:00 PM CST showing the air mass passing over southern Georgia.

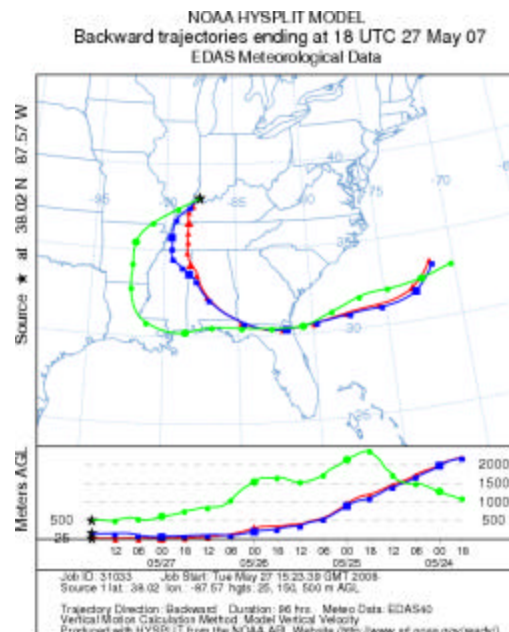


Figure 11.5: Backward trajectories originating from Evansville on 5/27/07 at 12:00 PM CST showing the air mass still arriving from over southern Georgia.

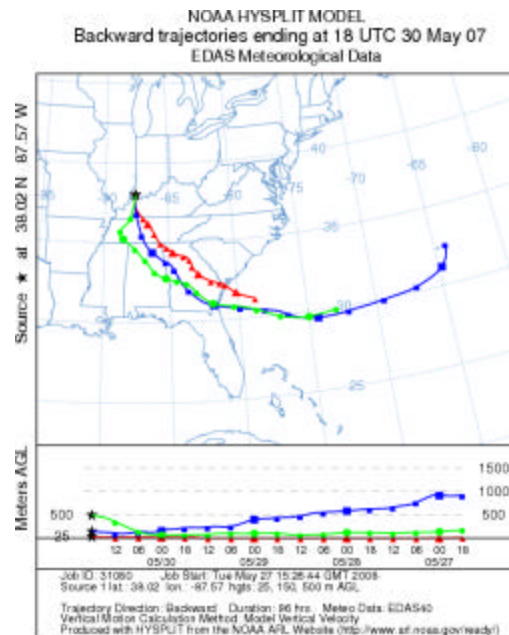


Figure 11.6: Backward trajectories originating from Evansville on 5/30/07 at 12:00 PM CST showing the air mass still passing over southern Georgia.